The sterile shoots vary from erect to depressed, but all the fertile collections (*Bruggemann* 186, *Senn & Calder* 3747, *Findlay* 260, and *Cody* 1703 & 1077) show only erect sterile stems, the depressed phase being apparently sterile.

It is a pleasure to attach to this species the name of my friend and co-worker J. A. Calder.

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## Two Problem-species: Schizoloma cordatum Gaud. and Syngramma pinnata J. Smith

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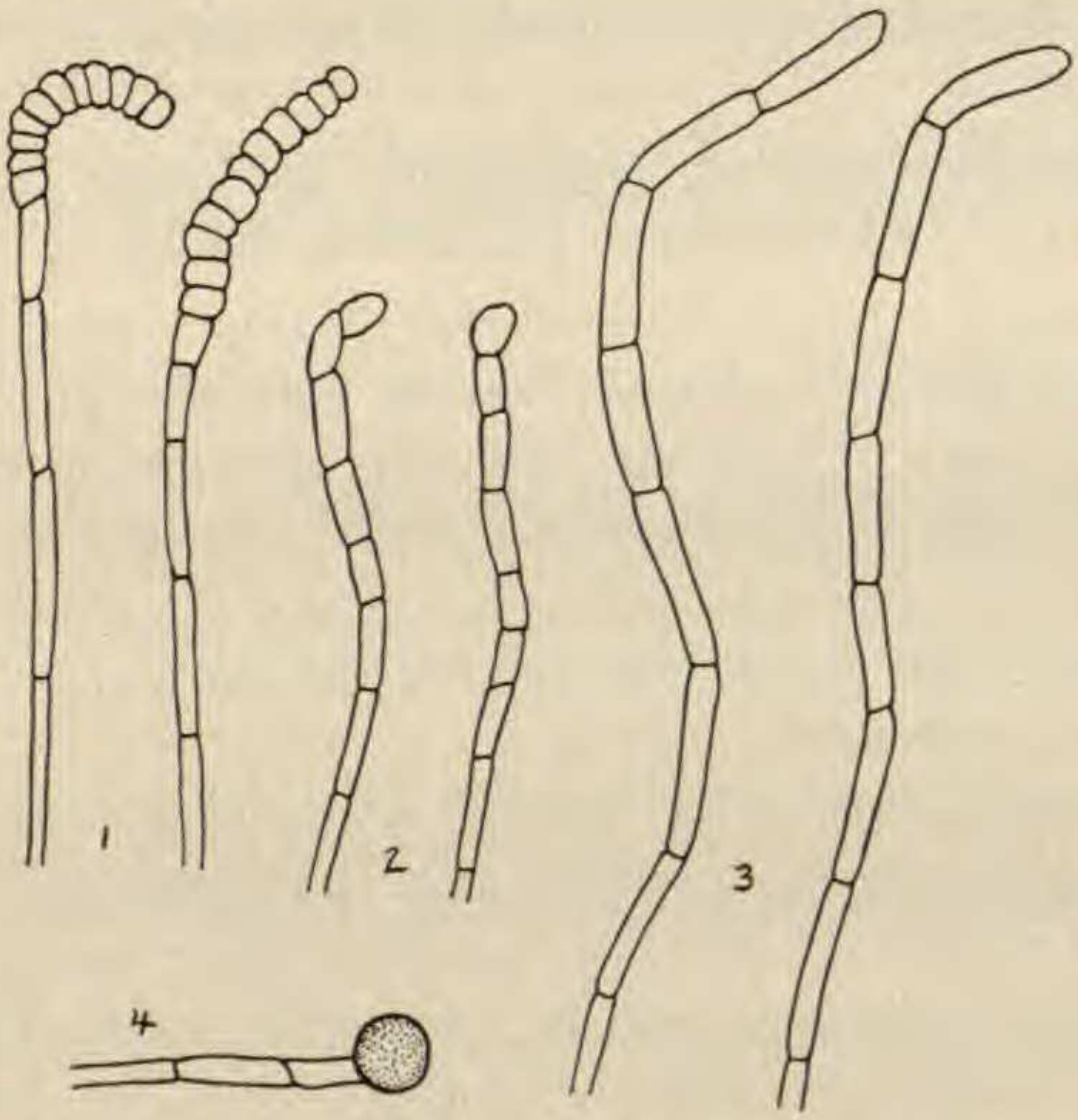
It is clear from Copeland's Genera Filicum (pp. 55, 57) that he considers both *Schizoloma cordatum* and *Syngramma pinnata* to be nearly related to the genus *Taenitis*. I agree with this statement, and wish to present further evidence for it than that given by Copeland. My conclusion will be that both species should be transferred to *Taenitis*.

*Schizoloma cordatum* has a fairly wide distribution in Borneo, the Philippine Islands, Celebes, and the Moluccas, but has not been very frequently collected. I believe the reason to be that it is confined to limestone, and of very local occurrence, often in places not easily accessible. Certainly, the only locality from which it is known in Sarawak is the limestone hill at Bau, near Kuching. But before dealing with morphology, a note on nomenclature is necessary.

The genus *Schizoloma* was established by Gaudichaud in 1824, and in it he placed three very diverse species: *S. cordatum*, *S. guerinianum* and *S. billardieri*. Fée later removed *S. cordatum* to a new genus *Schizolepton* and *S. guerinianum* to *Isoloma*, leaving *S. billardieri* in *Schizoloma*. Copeland states that in so doing Fée misconstrued *Schizoloma*, but he does not explain what he means by that statement. Fée correctly construed *Schizoloma* Gaud. as a mixture, and had the right to choose how he would resolve that mixture. In so doing, he effectively chose *S. billardieri* as the type species of *Schizoloma*. *S. billardieri* (=

*Lindsaea ensifolia* Swartz) undoubtedly belongs to the genus *Lindsaea* as defined in the recent monograph of Kramer and as accepted by Copeland, and thus *Schizoloma* becomes a synonym of *Lindsaea.*[1] The correct name for *Schizoloma cordatum* is thus *Schizolepton cordatum* (Gaud.) Fée; there is no other known species of *Schizolepton.*




PARAPHYSES, ALL × 70: 1, TAENITIS BLECHNOIDES; 2, SYNGRAMMA PINNATA; 3, SCHIZOLEPTON CORDATUM; 4, SYNGRAMMA ALISMIFOLIA

*Schizolepton* differs from *Lindsaea* in having rigid cylindrical bristles, each consisting of a single series of cells, as a covering of the young parts of its rhizome. The rhizome of *Lindsaea* bears distinctly flat scales. In its sorus *Schizolepton* superficially resembles those species of *Lindsaea* (e.g. *L. ensifolia*) which have a continuous sorus all along the edge of each leaflet. But in *Lindsaea* the sorus is protected by a thin indusium which is quite distinct in substance from the true margin of the frond. In *Schizolepton* the sorus is in an apparently marginal groove, and the two edges of the groove are exactly alike in substance. I

[1] Cf. Kramer, Acta Bot. Neerl. *6*: 97–138. 1957.

think that the conclusion is inescapable that the sori in *Schizolepton* and *Lindsaea,* though superficially similar, have had quite different evolutionary origins. Thus, both in protective bristles on the rhizome, and in the nature of the protection of the sorus, *Schizolepton* is quite different from *Lindsaea.* Equally, it is distinct from *Isoloma* (it seems to me that Copeland is wrong in suggesting that *Isoloma* is related to *Schizolepton*). A third striking difference is the presence in *Schizolepton* of abundant rather thick hair-shaped paraphyses (*fig. 3*), as long as the sporangia, each consisting of a row of about eight cells, the lower cells gradually more slender, the apical one not of distinctive form; paraphyses in *Lindsaea* are much fewer and shorter, usually of two cells. (Fée gave a drawing of a paraphysis of *Schizolepton,* but omitted to show that it consists of a row of separate cells.)

Fée compared *Schizolepton* to *Vittaria,* and in my opinion the apparently marginal soral groove in the two genera is of exactly comparable structure, the two lips of the groove being of equal substance. But it is certain that *Schizolepton* and *Vittaria* are not closely related, and I believe the development of similar sori in the two cases is due to parallel evolution.

In his comments on *Schizolepton,* Copeland writes "related to *Taenitis,* in spite of being indusiate." As we have just noted, it is not indusiate. But it is certainly related to *Taenitis,* agreeing in rhizome-bristles, in venation, and in the nature of its paraphyses. Copeland states that *Taenitis* has "peculiar paraphyses which resemble abortive sporangia." But in fact the paraphyses of *Taenitis* are similar to those of *Schizolepton,* consisting of a single row of thin-walled cells (*fig. 1*) ; the difference is that in *Taenitis* there are more cells in each paraphysis (about 16) and the apical 10-12 cells are much shorter than the rest. In a dried specimen, the cells of a paraphysis collapse and turn brown, but if they are soaked in an alkaline bleaching solution they lose the brown colour and expand to their orginal shape. The paraphyses in *Taenitis blechnoides* develop before the sporangia, and their swollen ends form a very effective protection for the young sporangia.

It appears to me that *Schizolepton* differs from *Taenitis* only in having the sorus in an apparently marginal groove instead of in a superficial position between midrib and edge. If we take the parallel case of *Vittaria*, we find some species with sori in shallow superficial grooves lying between midrib and edge, and others with sori in apparently marginal grooves. Comparing *Vittaria* with the related genus *Antrophyum*, it seems probable that the elongate superficial sorus is primitive in *Vittaria*, and that the apparently marginal sorus is due to the upgrowth of the inner edge of a groove which at first is superficial. The sorus of *Schizolepton* bears the same relation to that of *Taenitis blechnoides* as the marginal type of sorus bears to the superficial type in *Vittaria*. As both kinds of sorus can occur in the one genus *Vittaria*, they could also occur in *Taenitis* (though here intermediate conditions are lacking) ; in fact, it would be quite a natural arrangement to transfer the species *Schizolepton cordatum* to *Taenitis*, and this I now do. The new combination is *Taenitis* **cordatum** (Gaud.) Holttum.[2]

Regarding *Syngramma pinnata* J. Smith, Copeland remarks "distinguished from *Taenitis* only by the sori and paraphyses." Here again therefore we have to look at paraphyses (*fig. 2*), and find that Copeland's statement is incorrect, because he did not know the true form of the paraphyses of *Taenitis* (though they were figured by Beddome in the Ferns of British India, *t.54*, in 1866). There is in fact close agreement between the paraphyses of *Syngramma pinnata* and *Taenitis blechnoides;* in *S. pinnata* the distal swollen cells are longer and fewer than in *Taenitis*, being about midway between those of *Taenitis blechnoides* and *Schizolepton cordatum*. But in other species of *Syngramma* the paraphyses are different; they have a glandular terminal cell which is quite different from the rest in shape, colour and contents (*fig. 4*).

[2] Basionym: *Schizoloma cordatum* Gaud. Ann. Sci. Nat. Paris *3:* 507. 1824.

The sorus in *Syngramma pinnata* is variable, a fact shown by Copeland in his *plate 1.* In what is regarded as the typical form of the species, the sori run along most of the veins, which form a network of oblique areoles (this venation is exactly as in *Taenitis*). In many specimens however the sori do not spread so much, and are more or less confined to the veins on a band about midway between the midrib of a leaflet and the margin, the sporangia more crowded than in the typical form and forming small patches. The sori in this variety occupy exactly the same position as the sori in *Taenitis blechnoides*, and if the gaps between them were filled they would be indistinguishable from the sori of *T. blechnoides*.

In shape of frond, and in venation, *S. pinnata* is exactly like *T. blechnoides;* sterile plants would be indistinguishable. The supposed difference in paraphyses is shown to be non-existent; in paraphyses *S. pinnata* resembles *T. blechnoides*, not the other species of *Syngramma*. On the other hand, there is no other *Syngramma* which has the frond-form and venation of *Taenitis*. To me, the conclusion is that *Syngramma pinnata* is properly a species of *Taenitis*, and I have transferred it to *Taenitis* in a recent paper.[3]

Prof. I. Manton has already recorded the chromosome number $n = 116$ $(4 \times 29)$ for *Syngramma quinata* (Hook.) Carr., as found in Malaya; this is probably not the true *S. quinata* of the Pacific, but a distinct Malaysian species.[4] She has recently found the number $n = 58$ $(2 \times 29)$ in a plant of *Syngramma alismifolia* (Presl) J. Smith brought to Kew from Sarawak; but another recent observation on *Taenitis blechnoides* gives a quite different chromosome number, $n = 44$. (Prof. Manton has informed me verbally of these two records, and I am grateful to her for permission to mention them here.) The chromosomes thus provide additional evidence that *Taenitis* and *Syngramma* are not closely related genera (though I believe that they are more closely related to each other than either is to *Lindsaea*).

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[3] Kew Bull. *1958:* 453.
[4] Cf. Holttum, Ferns of Malaya, pp. 580, 627. 1954.